

CLAIMS

1. A tomosynthesis method for creating a three-dimensional reconstruction of a target element comprising:

5 acquiring radiation absorbance images of the target element through a limited plurality of angles; and

applying an iterative reconstruction algorithm to generate the three-dimensional reconstruction of the target element;

10 wherein the iterative reconstruction algorithm is applied using cone-beam forward projection and back projection.

2. A method according to claim 1, wherein the radiation absorbance images are acquired by transmitting x-ray energy from an x-ray source through the target element to an x-ray detector.

15 3. A method according to claim 2, wherein the x-ray detector is a digital x-ray detector having a plurality of detector pixels.

4. A method according to claim 1, wherein radiation absorbance images are acquired through a number of angles that is less than or equal to about 100.

20 5. A method according to claim 1, wherein radiation absorbance images are acquired through a range of angles that is between about 30 and 120 degrees.

25 6. A method according to claim 1, wherein the iterative reconstruction algorithm is a maximum likelihood algorithm.

7. A method according to claim 3, wherein the three-dimensional reconstruction of the target element is represented as an array of voxels having a uniform or non-uniform size in three-dimensions.

8. A method according to claim 7, wherein a forward projection step is implemented by ray tracing from the x-ray source to a detector pixel and the forward projection of the target element is obtained by repeating the ray tracing for each detector pixel to calculate an attenuation value for each voxel.

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9. A method according to claim 8, wherein a back projection step is implemented by locating detector pixels containing attenuation information relating to a selected voxel and using those pixels to update the attenuation value of the selected voxel.

10 10. A method according to claim 9, wherein the back projection step includes performing a back projection for at least each voxel corresponding to a three-dimensional reconstruction of the target element.

11. A method according to claim 6, wherein the maximum-likelihood estimation is
15 implemented using an expectation-maximization algorithm.

12. A method according to claim 1, wherein the target element is at least a portion of a human patient.

20 13. A method according to claim 12, wherein the target element is a breast of a female human patient.

14. A method according to claim 1, wherein the number of iterations is less than or equal to about 10.

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15. A system for three-dimensional tomosynthesis imaging of a target element comprising:
an image acquisition element for obtaining a plurality of images of the target element
from a plurality of angles having:

a radiation source positionable at a plurality of angles with respect to the
30 target element; and

a radiation detector positioned so as to detect radiation emitted by the radiation source passing through the target element and determine a plurality of attenuation value for radiation passing through the target element to establish a radiation absorbance projection image of the target element for a particular radiation source angle; and

a processor configured to apply an iterative reconstruction algorithm to the radiation absorbance projection images of the target element obtained from a plurality of radiation source angles to generate a three-dimensional reconstruction of the target element wherein the iterative reconstruction algorithm is applied using cone-beam forward projection and back projection.

16. A system according to claim 15, wherein the radiation detector is a digital x-ray detector having a plurality of detector pixels.

17. A system according to claim 15, wherein radiation absorbance projection images are acquired through a number of angles that is less than or equal to about 100.

18. A system according to claim 15, wherein radiation absorbance projection images are acquired through a range of angles that is between about 30 and 120 degrees.

19. A system according to claim 15, wherein the iterative reconstruction algorithm is a maximum likelihood algorithm.

20. A system according to claim 16, wherein the three-dimensional reconstruction of the target element is represented as an array of voxels having a uniform or non-uniform size in three-dimensions.

21. A system according to claim 20, wherein a forward projection step is implemented by ray tracing from the radiation source to a detector pixel and the forward projection of the target element is obtained by repeating the ray tracing for each detector pixel to calculate an attenuation value for each voxel.

22. A system according to claim 21, wherein a back projection step is implemented by locating detector pixels containing attenuation information relating to a selected voxel and using those pixels to update the attenuation value of the selected voxel.

5 23. A system according to claim 22, wherein the back projection step includes performing a back projection for at least each voxel corresponding to a three-dimensional reconstruction of the target element.

24. A system according to claim 19, wherein the maximum-likelihood estimation is
10 implemented using an expectation-maximization algorithm.

25. A computer program for three-dimensional tomosynthesis imaging of a target element from a plurality of radiation absorbance projection images obtained at a different angles from an image acquisition element having a radiation source positionable at a plurality of angles with
15 respect to the target element and a radiation detector positioned so as to detect radiation emitted by the radiation source passing through the target element and determine a plurality of attenuation value for radiation passing through the target element to establish a radiation absorbance projection image of the target element for a particular radiation source angle, the computer program code being embodied in a computer readable medium and comprising:

20 computer program code for applying an iterative reconstruction algorithm to the radiation absorbance projection images of the target element obtained from a plurality of radiation source angles to generate the three-dimensional reconstruction of the target element wherein the iterative reconstruction algorithm is applied using cone-beam forward projection and back projection.

25 26. A computer program according to claim 25, wherein the radiation detector is a digital x-ray detector having a plurality of detector pixels.

27. A computer program according to claim 25, wherein radiation absorbance projection
30 images are acquired through a number of angles that is less than or equal to about 100.

28. A computer program according to claim 25, wherein radiation absorbance projection images are acquired through a range of angles that is between about 30 and 120 degrees.

29. A computer program according to claim 25, wherein the iterative reconstruction
5 algorithm is a maximum likelihood algorithm.

30. A computer program according to claim 26, wherein the three-dimensional reconstruction of the target element is represented as an array of voxels having a uniform or non-uniform size in three-dimensions.

10 31. A computer program according to claim 30, wherein a forward projection step is implemented by ray tracing from the radiation source to a detector pixel and the forward projection of the target element is obtained by repeating the ray tracing for each detector pixel to calculate an attenuation value for each voxel.

15 32. A computer program according to claim 31, wherein a back projection step is implemented by locating detector pixels containing attenuation information relating to a selected voxel and using those pixels to update the attenuation value of the selected voxel.

20 33. A computer program according to claim 32, wherein the back projection step includes performing a back projection for at least each voxel corresponding to a three-dimensional reconstruction of the target element.

25 34. A computer program according to claim 29, wherein the maximum-likelihood estimation is implemented using an expectation-maximization algorithm.